

Sue Na Meter

Joyce E. Patterson Stark
Albert Einstein Distinguished Educator Fellow
National Oceanic and Atmospheric Administration
Office of Education and Sustainable Development
Herbert Hoover Building Room 6863
14th and Constitution Avenue NW
Washington, D.C. 20230
Joyce.Stark@noaa.gov

Inquiry involves teaching that incorporates discovery. It will take longer and the teacher may require more in depth knowledge before doing the activity.

Lesson Objective

Using a constructivist approach, students will make a simulated tsunameter to understand the difference between low and high tides and a tsunami waves. Sue Na Meter should be compared to the students' first, middle and last names in order to help with pronunciation but also make a word association to remember the concept.

Teacher Preparation

This inquiry activity could be used from grades 3-8 with some modifications for the middle school students. Teachers may just want the younger students to cut and fold the parts to make the meter. Middle school students may want to measure the dimensions of the pieces in centimeters to practice math skills. The model may be constructed from any type of paper. Construction paper is a little heavier and better supports the wave construction. Depending on the grade level, amount of class time or student abilities you may want to cut out the major pieces for them. This activity will take more than one 44 minute class period. A block of time would be the most effective.

Generate a discussion with your students by using some sample questions. They can record some questions in their journals. After brainstorming with these sample questions, ask them to write or draw a picture in their journal as to what they think a tsunami (soo-nah-mee) is. Do the activity first. Don't share the background with the students yet. You want to see what they already know, build on that knowledge by allowing them to discover this experience themselves and then discuss the background. Teachers will be able to observe any misconceptions as the students make and use their Su Na Meter.

Teacher Background

This information is to prepare the teacher to do the inquiry lesson and then can be used for discussion after the construction of the Sue Na Meter. These words will be needed to label the meter and understand how it operates.

Crest - top of the wave (peak).

Trough – lowest point between waves (bottom). For every crest there is a trough. If the trough appears first on the shore, the sea recedes before the crest of the wave arrives on land. Sometimes this is referred to as a negative wave.

Surge – a large wave. Water builds up and this wave rushes on shore.

Tsunami – a series of waves that have long wavelengths and periods. They are generated in a body of water by an impulsive disturbance (such as an earthquake) and then that water is displaced.

Period - time between two successive waves.

Wavelength - distance between crest of one wave to the crest of another wave.

Wave train - a series of 7 -10 long waves that could be 5-90 minutes apart.

In the deep ocean, waves can travel 500 mph or more (as fast as a commercial jet liner) but the crest of the wave may only be about 15-20 inches high. Waves slow down as they approach the shore, but the height of the wave increases sometimes up to 100 feet.

The Pacific Marine Environmental Laboratory conducts tsunami research. The National Tsunami Hazard Mitigation Program's *Tsunamis:FrequentlyAsked Questions* will give additional background information.

http://www.pmel.noaa.gov/tsunami-hazard/tsunami_faqs.htm

Inquiry- Generating Questions

These are examples of some questions to ask your class before constructing the tsunameter.

1. How many have actually visited a beach?
2. Have you gone beachcombing?
3. What types of organisms have you found on the beach?
4. How did they get there?
5. Are there any buildings on the beach?
6. If you have been on a beach for a long time, have you noticed a difference in the water levels?

Ask the students to describe a beach (include a diagram) in their journal.

Ask the students if they have heard of a tsunami. If they know, have them describe it in their journals.

Student Procedures

1. Fold a piece of paper (8.5" X 10") in half using a hot dog fold.
2. Cut along the fold.
3. Lay the one half aside.
4. Take the other piece and divide into 3 pieces using a hot dog fold. Each of the three pieces should be 1 3/8" wide (3.6cm) and 10" long (28cm).
5. Cut along the folds to get three separate pieces (3.6 cm X 28 cm).
6. Place the piece that was set aside in front of you on the table.
7. From the left hand side measure in 10 cm and draw a dotted line (use pencil) along the width of the paper. Label this dotted line **shoreline**.
8. On the dotted line, darken the line (between 4-7.5 cm) and then cut a slit along this darkened section of the line. Cut another opening of the same length, 1 cm to the left of this slit.
9. Insert one of the long strips into one slot and then through the other. Pull it through the slots and until it covers the length of the other paper.
10. Using dotted lines outline this strip on the white paper. Remove the strip and there should be an outline of dotted lines marking the position of the strip. This area to the right of the shoreline will represent a strip of beach. Design what you would like to see on this strip of beach and color the beach light brown.
11. Color this strip blue or you could have used blue construction paper. Draw 10 small waves across the top of this strip. The crests should only be 0.3 cm high
12. Insert the blue strip through the slots until it is even with the dotted shoreline. This is **low tide**.
13. Move the wave forward 1 cm from the slot. then continue to move the blue strip of waves forward until you reach 7 cm. This is **high tide**.

IQ (Inquiry Question)

What is happening to the beach as low tide changes to high tide? Write this in your journal.

14. Now pull the wave back through the slots until the blue strip returns to low tide. Continue pulling the strip until the entire length has passed through the slots.

IQ

What will happen to your beach if all the water follows that wave out to sea?

There are numerous sea shells now visible on the beach
Should you walk out further than the dotted shoreline?

Does this seem unusual that the water just suddenly left the beach?

Teacher note: Discuss at this point that this receding wave is a sign that a disturbance, such as an earthquake, had occurred and a tsunami may be arriving. Everyone should leave the beach immediately and move to higher ground as far from the beach as possible.

15. Tape the ends of the other two strips together to make a longer wave strip. Color the strips blue or use colored paper. Draw three long waves along this strip. One wave crest should be at the right edge of the strip and one at the left edge of the ocean strip and one will be in the middle. The height of the crest should be 4.5 cm and the distance between each wave should be 7.5 cm. The trough width (bottom) will be only 1 cm (very thin) from the lower edge of the wave strip.
16. Insert the edge of the large wave (surge) into the slot and put it through to the other side of the paper. The large surge wave will cover the width of the beach as the strip is moved. When this wave surge reaches the end of the paper, the thin trough will be lying along the strip that was the beach.

IQ

What has this leading wave (surge) done to the beach?

What could this wave do to people if they were still on the beach?

Is the tsunami over?

17. Pull the wave strip until another wave surge travels across the beach.

IQ

Is there just one tsunami wave?

Which are larger? : Waves from tidal changes or tsunami waves?

Teacher Note: Discuss the speed of waves, wave train and time between waves.
Emphasize move to higher ground. Don't forget to inform others on the beach.

Is it safe to return to the beach?

18. Pull the tsunami wave strip until another wave surge travels across the beach.

19. How many waves were in that wave train?

20. What is the difference between low/high waves and tsunami waves?

21. Why are tsunami waves dangerous?

22. Draw a tsunami wave and label the parts.
23. Write in your journal, what you should do when you see water suddenly receding from the beach. Explain why.

Teacher Note: Review evacuation procedures and the importance of moving to higher ground. Review the words that are needed to label the tsunami wave. The students should have tried first to label the wave. Practice again using the low/high tide waves and tsunami waves.

Assessment

A three point rubric will be used to evaluate the students' work during the lesson.

- 3 points Students have constructed the Su Na Meter and can demonstrate low and high tides and tsunami waves. They have written in their journals explaining what to do if they are on a beach and see the ocean receding (leaving) suddenly. They should be able to explain why. Give them two tsunami logos to be glued or taped into their journals.
- 2 points Students have constructed the Su Na Meter and can demonstrate low and high tides and tsunamis waves but they have not written a response to what they should do if they see wave receding and why.
- 1 point Students have only partially completed the Su Na Meter and did not write at all in their journals.

The students who received three points, will receive two tsunami logos to glue or tape in their journals. If the students only received 1 or 2 points then have them finish their work and then give them only one of the logos for their journal. Go to the following website of the International Tsunami Information Center. Click on Photo Gallery and the logos can be downloaded. <http://www.prh.noaa.gov/itic>

National Science Educations Standards

Grades K-4

Content Standard A	Abilities to do scientific inquiry Understanding scientific inquiry
Content Standard B	Position and motion of objects
Content Standard D	Properties of Earth materials
Content Standard F	Changes in environments

Grades 5-8

Content Standard A	Abilities to do scientific inquiry Understanding scientific inquiry
Content Standard B	Motion and forces Transfer of energy
Content Standard D	Structure of Earth system Earth's history
Content Standard F	Natural hazards Risks and benefits
Content Standard G	Nature of science